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Ecological Study Of The Mangrove Ecosystem In Ambon City To Support The Balance Of Carbon Emissions And Absorption

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Abstract
Mangroves are tropical coastal vegetation communities dominated by several species of mangrove trees which are able to grow and develop in muddy coastal tidal areas. The research that will be achieved is analyzing the diversity of mangrove vegetation an analyzing the diversity of mangrove animalsherefore, mangrove forest management must include a management plan that optimizes the conservation of mangrove resources to meet human needs. The results of the analysis show that the largest distribution of species is dominated by Avicennia alba and Sonneratia alba. Avicennia alba was found in 14 plots while Sonneratia alba was found in 24 plots. These two types are also types that are resistant to high inundation and are able to survive being flooded for long periods of inundation and are able to live in high salinity conditions. Salinity conditions range between 15-25 ‰ and Avicennia sp, Sonneratia sp are types that are able to adapt to high salinity conditions. The frequent occurrence of Sonneratia alba (47.1%) and Avicennia alba (27.5%) shows that the mangrove forest habitat is special, but each type has its own ecological range. The types that have a high INP, namely Sonneratia alba (105.1%) and Avicennia alba (65.7%) have a greater chance of being able to maintain the growth and sustainability of their species because they are the dominant species. Sonneratia alba and Avicennia alba have the highest number of individuals compared to other mangrove types with a percentage of 57.03 (203 individuals) and 37.64% (134 individuals). There were only 4 types of birds found, the river kingfisher (Todiramphus chloris), the garden fan (Rhipidura leucophrys), the beach trinil (Acitis hypoleucos), and the forest crow (Corvus enca) mangroves are not too dense.

Keywords : *Mangrove forest; coastal; Frequency ; dominance; INP*

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I. Introduction

Indonesia, which is part of the global community, continues to be committed to controlling and stabilizing the earth's temperature between 1.5 – 2.0 degrees Celsius from pre-industrialization temperature levels. This commitment was realized by signing the Paris Agreement and implementing the commitment through the Updated Nationally Determined Contribution (Enhanced NDC) document for each country. Indonesia has targeted a reduction in Green House Gas (GHG) emissions by 29 percent with independent efforts, and an increase in the target to 41 percent with financial and technological support from developed countries, both governmen Mangroves are tropical coastal vegetation communities dominated by several species of mangrove trees which are able to grow and develop in muddy coastal tidal areas. This vegetation community generally grows in intertidal and supratidal areas that receive sufficient water flow, and are protected from large waves and strong tidal currents. Because of this, mangrove forests are often found on shallow bay beaches, estuaries, deltas and protected coastal areas (Dahuri et al., 2001). The structure, function, composition and distribution of species and growth patterns of mangroves are very dependent on environmental factors.t and private.

In implementing the 2020-2030 NDC, Indonesia has also established a road map as a direction for stakeholders, both government and non-government. They can contribute to efforts to achieve NDC targets by providing information on physical targets, timelines, and indications of potential locations for implementing mitigation actions, as well as parties who can contribute to their implementation. This road map can also help align the programs and activities to achieve the set NDC targets.

Indonesia's FoluNet Sink 2030 determines mitigation actions from the forestry sector category by

taking into account the activities contained in the REDD+ scheme. Based on the results of meetings and discussions with experts, academics, researchers, and practitioners, it was determined that mitigation actions that can contribute to reducing emissions or increasing absorption from the forestry sector category include 6 (six) mitigation actions as follows: (a). Reducing deforestation; (b). Reducing forest degradation; (c). Sustainable forest management (Sustainable Forest Management); (d). Increase in carbon stocks; (e). Increasing the role of conservation; (f). Peatland management . Increasing the role of conservation is one of the mitigation actions that can be carried out as an effort to reduce emissions/increase GHG absorption. Mitigation action to increase the role of conservation can be carried out through the mitigation action component in the form of establishing high conservation value (HCV) areas.

The area of mangrove forests in Negeri Rutong, South Leitimur District, Ambon City is 3.15 Ha (BPKH Maluku, 2023). The existence of mangrove forests in Rutong State which is currently being used as a tourist attraction requires identification of its biodiversity and environmental services so that it can become the basis for directing recommendations for future management policies.

The principle of sustainable development has a general effect on the entire decision-making context by integrating the concepts of justice, environment, and economics, specifically the impact on the economic dimension, environmental resource management, and socio-cultural development (Wiharyanto & Laga, 2010). This research aims to analyze the diversity of mangrove vegetation and animals as well as other ecological supporting aspects.

II. Material and Methods

This research was conducted in Rutong Village, Ambon City, in July-September 2023.

Figure 1. Research location in Rutong Village

Data collection technique

Observation

Observations were made on the vegetation of the mangrove ecosystem with a focus on biodiversity which includes a diversity of vegetation and animals

Interview

Interview activities were carried out with respondents from the surrounding community regarding the types of vegetation and animals that have been encountered or that have been known for generations but

are threatened with extinction. Random selection of respondents by determining respondents who are foundwill be used as respondents (incidental).

INP= Relative density + Relative Frequency + Relative Dominance

A. Bird Watching

Data regarding the diversity of bird species can be obtained using the point abundance method or IPA (Index Point of Abondance). Index Point of Abondance (IPA) is a bird observation method by taking samples from bird communities at certain times and locations. Observations are carried out by the observer remaining stationary at a point that has been chosen systematically and previously determined (Helvoort, 1981).

At the research location, 3 observation stations were made, the observation process was carried out in the morning period from 06.00 – 09.00 WIT and the afternoon observation period was carried out from

16.00 – 18.00 WIT. Form an example unit in bird observation using the method IPA is a circle whosediameter or circle radius is 50 m, with a distance between the center points of 100 m.

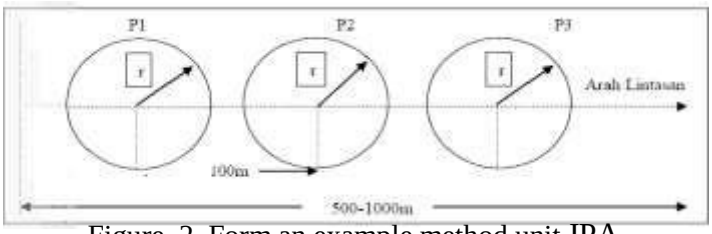

Figure 2. Form an example method unit IPA

Where: P = Observation point,

r = Circle radius determined based on average visibility (50m).

The data recorded are bird species, number of species, and bird activity at the time of observation, both heardand seen by the observer in the observation plot.

Vegetation Data Collection Method

The vegetation level criteria were modified from Soerianegara and Indrawan (1982), namely; seedlings (D) for vegetation <1.5 m; stake (C) height >1.5 m; with diameter <10 cm; poles (B) for those with diameters >10 cm and <20 cm; and trees (A) for those with a diameter of ≥ 20 cm. A sketch of the observation plot for the presence of birds and vegetation is presented in the picture below.

Data Analysis

Plant species diversity data was identified through the Diversity Index (Shannon & Wiener, 1963; Fachrul, 2012). where: Information H' (Shannon Wienner diversity index), S (Number of species), Ni (Number of individuals in one species), Ln (Natural logarithm), N (Total number of individuals of the species found). The value of H' determines the level of species diversity in an area, where the definition of the value of species diversity according to Shannon Wienner is H'>3= High species diversity, 1≤H'≤3= Medium species diversity, H'<1= Species diversity low. The species evenness index refers to the Pielow evenness index formula (Ludwig & Reynolds, 1988), namely: E= H'/ln S, where E (Evenness Index), and H' (Shannon-Wienner diversity index).

III. Results and Disccusions

Vegetation Analysis

Vegetation data was collected by creating 32 observation routes. From the 32 paths, 3 types of pure mangroves (major mangroves) were found, 2 types of minor mangroves from 5 different families, namely: *Avicennia alba, Sonneratia alba, Rhizophora mucronata, Scyphiphora hydrophyllacea* and *Aegiceras corniculatum* and 2 associated types from 2 families, namely Ketapang (*Terminalia catappa*) from the Combretaceae family and Coastal Ironwood (*Pongamia pinnata* Merr) from the Sapindaceae family. The overall types of mangroves identified can be seen in table 1 and table.2.

Table 1. Types of Mangrove Vegetation Found in Rutong State

Number.	Vegetation	Family	Keterangan
1	*Avicennia alba*	Avicenniaceae	Mangrove Major
2	*Sonneratia alba*	Sonneratiaceae	Mangrove Major
3	*Rhizophora mucronata*	Rhizophoraceae	Mangrove Major

4	*Scyphiphora hydrophyllacea*	Rubiaceae	Mangrove Minor
5	*Aegiceras corniculatum*	Myrsinaceae	Mangrove Minor
6	*Terminalia catappa*	Combretaceae	Mangrove Asociation
7	*Pongamia pinnata* Merr	Sapindaceae	Mangrove association

Based on the results of observations and identification of mangrove vegetation types, it was found that of the 32 observation routes, there were very dominant types of mangroves, namely Avicennia alba and Sonneratia alba. The results of the analysis show that the largest distribution of species is dominated by Avicennia alba and Sonneratia alba. Avicennia alba was found in 14 plots while Sonneratia alba was found in 24 plots. These two types are also types that are resistant to high inundation and are able to survive being flooded for long periods of inundation and are able to live in high salinity conditions. This is thought to be because this area has sufficient supporting capacity for the growth and development of mangrove plants, such as salinity, temperature and soil pH. Salinity conditions range between 15-25 ‰ and Avicennia sp, Sonneratia sp is a type that is able to adapt to high salinity conditions, this is because Avicennia sp has special glands that are able to excrete excess salt onto the surface of the bark and leaves, this is in line with what was stated by Zaky et al (2012).

Mangrove forests are a transition area between sea and land very extreme gradients of environmental properties. The tides cause this the occurrence of changes in several large environmental factors, especially temperature and salinity. Therefore, only a few types of plants that have a high tolerance for quite extreme environmental factors are capable survive and thrive in it. This condition also occurs This causes low species diversity, but on the other hand, population density each type is generally high.

Table 2. Mangrove Vegetation INP at Tree Level

Number.	Species	∑	∑ Plotfound	K	KR(%)	F	FR(%)	INP(%)
1	*Sonneratia alba*	203	24	89,04	58.0	0.421	47.1	105.1
2	*Avicennia alba*	134	14	58,77	38.3	0.246	27.5	65.7
3	*Rhizophora mucronata*	11	11	4,82	3.1	0.193	21.6	24.7
4	*Terminalia catappa*	1	1	0.44	0.3	0.018	2.0	2.2
5	*Scyphiphora hydrophylla*	1	1	0.44	0.3	0.018	2.0	2.2
	Amount			**153,51**	**100**	**0,895**	**100**	**200**

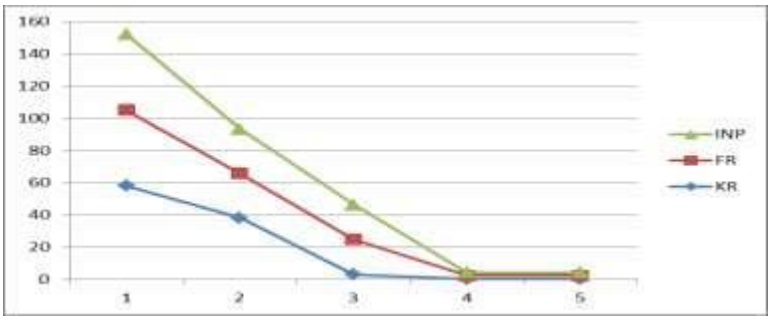

Figure 1. Density, Frequency and INP of Mangrove

The frequency of finding Sonneratia alba (47.1%) and Avicennia alba (27.5%) shows that the mangrove forest habitat is special, but each type has its own ecological range, so this condition causes the formation of various communities and even forests. or zoning, so that competition types differ from one place to another. The emergence of the demand phenomenon that occurs in mangrove forests is closely related to several factors, including soil type, openness of the mangrove area from crashing waves, salinity and the influence of tides.

The types that have a high INP, namely Sonneratia alba (105.1%) and Avicennia alba (65.7%) have a greater chance of being able to maintain the growth and sustainability of their species because the dominant species are those that can utilize the environment they occupy efficiently compared to other types in the same place. Plants with high INP have better adaptability, competitiveness for growing places and reproductive abilities compared to other plants in a certain area (Rahmasari et al., 2019), Rofi'i et al., (2021) explained that the composition The composition of the mangrove ecosystem is greatly influenced by existing habitat factors, even if there is a change in the quality of the mangrove habitat, it has the potential to change the composition of the type of mangrove vegetation. The different environmental characteristics of one location and another location can cause the composition and distribution of species to be different in each location, because it depends on their adaptability.

Table 3. Percentage of Mangrove Vegetation Composition

.	Number	Species	Family	Number of Individual	Komposisi Mangrove (%)
	1	*Avicennia alba*	Avicenniaceae	134	37,64
	2	*Sonneratia alba*	Sonneratiaceae	203	57,03
	3	*Rhizophora mucronata*	Rhizophoraceae	11	3,04
	4	*Scyphiphora hydrophyllacea*	Rubiaceae	1	0,28
	5	*Aegiceras corniculatum*	Myrsinaceae	1	0,28
	6	*Terminalia catappa*	Combretaceae	1	0,28
	7	*Pongamia pinnata* Merr	Sapindaceae	5	1,42
		Amount		356	100

Table 3 can be seen that Sonneratia alba and Avicennia alba have the highest number of individuals compared to other mangrove types with percentages of 57.03 (203 individuals) and 37.64% (134 individuals). This is because Sonneratia alba and Avicennia alba are able to adapt to their environment (Kurniawan, 2005). Based on observations in the field, it shows that mangrove biodiversity in Rutong is still relatively moderate, mangroves have high adaptability even though the mangrove community is spread unevenly, this condition shows that each individual mangrove does not compete in meeting their daily needs. Competition in an ecosystem is often caused by competition for life's necessities, be it sunlight, space to grow or nutrients (Nurhamiyawan et al., 2013). The nutrients needed by mangroves for growth are nitrogen and phosphorus,while for growth in height and trunk diameter, mangroves are very dependent on growing space, canopy surface, relative humidity, root system, climate influence and soil fertility (Lovelock et al., 2004); (Syah et al., 2012). Several factors that contribute to the spread and growth of mangroves are drying due to tides, predation and competition, where the competition of a plant is very dependent on the speed of root growth, while the speed of root growth depends on the ability of photosynthesis (Indriyanto, 2008). Apart from that, substrate characteristics (Budiasih et al., 2015), the presence of sedimentation (Purnobasuki, 2011), as well as human intervention (Smith et al., 2003), average sea surface height (Purnobasuki, 2011), physicochemical factors Water (Hamzah & Pancawati, 2013) also influences mangrove growth.

During the research, it was also found that almost all types of mangroves were bearing fruit and flowering, this is related to the availability of food such as fruit, seeds, insects, fish, shrimp, as well as quite a lot of invertebrates, thus affecting the diversity of animal species in the mangrove area. . This is in accordance with the statement by Sari et al., 2019, that mangrove forests are a source of food and habitat for the survival of various types of wild birds. Several types of birds use mangrove vegetation as a place to rest, sleep and nest. Mangrove vegetation is also used by several types of birds as a temporary stop over area and place to find food, because the mangrove ecosystem is a rich ecosystem (Iswandaru, et al., 2018). The coastal ecosystem behind the mangrove forest is also quite diverse, with annual and annual plants dominated by fruit trees and shrubs. Plants that grow naturally in the area behind the mangroves are dominated by Ketapang (*Terminalia catappa*), Bintanggur (*Calophyllum inophyllum*), Hutung (*Barringtonia asiatica*), Gayam (*Inocarpus edulis*), Waru (*Hibiscus tiliaceus*), Papapeda (Scaevola frustescens), Mango berabu (*Cerbera manghas)*, Pandan (Pandanus sp.), Coastal ironwood (*Pongamia pinatta*) and Coconut (*Cocos nucifera*) and Sago (Metroxylon sp). The dominance of several types of mangroves in the research area shows that animals often use mangroves to carry out their daily activities

The benefits and functions of mangroves are quite large for coastal communities and also for the ecosystem behind mangroves, so it is appropriate that the mangrove area needs to be preserved and maintained, considering that the coastal area of Rutong State is seen to have experienced quite serious coastal erosion, even in certain seasons the coastal area of Rutong State. will be filled with consigned waste in the form of plastic waste and used logs which come in very large quantities.

Animal Analysis

River Kingfisher (*Todiramphus chloris*)

(*Rhipidura leucophrys*)

Trinil Pantai *(Acitys hypoleucos*)

Forest Crow (*Corvus enca*)Figure 2.

Various types of birds found in the mangrove area of Rutong State

Table. 4. Types of birdlife found in the research area

Number	Species	Scientific name	Famili	Ordo	Conservation status
1	River Kingfisher	*Todiramphus chloris*	Alcedinidae	Coracliformes	Beresiko Rendah (LC), (IUCN 3.1),
2	Acitys hypoleucos	*Rhipidura leucophrys*	Rhipiduridae	Passeriformes	Beresiko Rendah (LC), (IUCN 3.1),
3	Trinil pantai	*Acitis hypoleucos*	Scolopacidae	Coracliformes	Beresiko Rendah (LC), (IUCN 3.1),(< V >)
4	Forest crow	*Corvus enca*	Corvidae	Passeriformes	Beresiko Rendah (LC), (IUCN 3.1),

E = Endemic to the Wallacea region, R = Resident, V = Visitor, does not breed, V (B) = Visitor, breeds, lnt = Introduced,

< = Also found in the west/north of the Wallacea region, > = Also found in the east / south of the wallacea region. Based on the research results, it can be seen that the types of birds that were found were insect-eating speciesand small fish and their numbers were very small because the Rutong State mangrove area was close to the community's residential area.

From table 4, it can be seen that only 4 types of birds were found, the river kingfisher (Todiramphus chloris), garden fan (Rhipidura leucophrys), beach trinil (Acitis hypoleucos), and forest crow (Corvus enca) bird species due to the mangrove habitat. Rutong Country is not too large and the distribution of mangroves is not too dense in the research area.

It can also be seen in table 4 that bird species are included in low risk conservation status or LC, because the species are not included in the IUCN red list. It is not listed as a threatened or endangered species and this species is not a conservation center because many birds are still found in the wild.

IV. Conclusion

1. The Rutong State mangrove area has mangroves with a distinctive composition dominated by Avicennia alba, Sonneratia alba and Rhizophora mucronata. These types are major mangrove types (main mangroves) which have quite a large role in protecting coastal areas. The types encountered are also types that are able to survive and adapt to local environmental conditions. Terminalia catappa and Pongamia pinatta are coastal species that are able to associate with major mangrove species.
2. The diversity of bird species found was only 4 types, including: river kingfisher (Todiramphus chloris),

garden fan (Rhipidura leucophrys), beach finches (Acitis hypoleucos), and forest crow (Corvus enca). The condition of bird life is less diverse, because the mangrove area is not too large.

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